SECTION I. INTRODUCTION

A. Purpose of Report

Since the early 1970's, the State of Hawaii has promoted policies to reduce its dependence on imported fossil fuel and the Hawaiian Electric Company (HECO) has been supportive of these policies through its many initiatives in alternative energy projects such as wind farms and geothermal energy. Under the direction of the State of Hawaii's Public Utilities Commission (PUC), HECO recently developed a long range plan for its future energy needs on Oahu. This effort culminated in a document titled "Integrated Resource Planning" (1) This document details generation demand-side strategies to the year 2013. One of the generation strategies that appears promising is pumped storage hydroelectric.

Pumped storage hydroelectric (PSH) operates on the basis that an overall increase in utility operating efficiency can be realized by pumping water from a lower reservoir to an upper reservoir during utility off peak hours and then using the flow to generate electricity during peak demand. PSH technology is well established and is represented by many large and small projects throughout the United States and the world. It has the advantage of reducing the overall consumption of fossil fuels and is generally considered environmentally clean since it results in a net reduction of gaseous emissions compared to other alternatives. In addition PSH plants have a relatively useful life of 50 - 100 years (2) compared to conventional fossil fuel technologies.

This report documents the work performed by the State of Hawaii Department of Land and Natural Resources (DLNR), the Department of Business Economic Development and Tourism, and HECO to examine the technical, economic, and environmental feasibility of a PSH facility on the Island of Oahu. The timing of this work is appropriate since the total lead time to develop a PSH facility is 8-12 years (2) and HECO studies indicate the use of PSH in about 2005.

The objective of this study is to determine the feasibility of installing a pumped storage hydroelectric facility at the Koko Crater and the Ka'au Crater/Maunawili Valley and to select one feasible site for further consideration.

B. Organization of Report

This document is organized into four parts;

First, it describes the work by HECO that lead it to consider PSH in its future generation mix, and to broadly identify some of the environmental and conceptual design considerations that needed to be addressed.

Second, a more in-depth discussion of environmental and legal considerations--based on literature search, field surveys and discussions with various agencies and individuals is presented.

Third, expanded design concepts of the two HECO concepts --one for the Koko Crater and the other for the Kaau Crater is discussed. The location of these sites is shown on figure I-1.

Fourth, recommendations on the environmental, technical and economic feasibility of each project are presented, as well as what future direction and effort should be undertaken for the Pumped Storage Hydroelectric concept for Oahu.

Several reports were prepared as part of this endeavor and are included in their entirety as appendices. The salient points in these reports are included in the body of this document.

C. BACKGROUND

1. Integrated Resource Planning

The State of Hawaii Public Utilities Commission (PUC) directed HECO to undertake an integrated resource planning effort with the goal as "the identification of the resources or the mix of resources for meeting near and long term consumer energy needs in an efficient and reliable manner at the lowest reasonable cost.". (1) The planners understood this goal would be achieved through balancing the customer, utility and societal perspectives.

Toward this goal HECO analyzed a matrix of feasible power generating resources, demand-side management programs, existing facilities replacement requirements, transmission lines, environmental considerations, statutory requirements, and costs. The planning horizon was over a time frame of twenty years to the year 2013. In this time frame it was projected that there would be an annual 1.6% long term growth in demand as well as the need to replace aging facilities. The IRP forecasts that peak demand would grow from the 1993 level of about 1200 megawatts (MW) to a 2013 level of about 1500 to 1800MW depending on whether the economic growth on Oahu is viewed as depressed or optimistic. This long range perspective allowed the consideration of demand side programs, such as solar and heat pump water-heating that would reduce the consumption of electricity, and consideration of generating facilities other than fossil fuel steam plants which are the major type of facility in the HECO system.

PSH was included in the IRP analysis because it provided for diversity of supply resources and it is a technology that is currently available through competitive bidding practices for utility application. Although PSH technology was not included in HECO's "preferred plan", PSH was considered a technology important enough to merit further study, and was included as an action item in the IRP 5-year action plan.

Two sites were identified in the IRP-Koko Crater and Kaau Crater/Maunawili. Although the work by HECO concluded that there would be significant environmental and societal impacts if either project were to go forward, PSH offered a cleaner alternative to a fossil

fuel plant. In addition, siting a generating plant in East Oahu could have beneficial effects on the stability and reliability of the HECO system.

Since some of the highest ranking integrated plans included PSH, HECO in cooperation with the DLNR and DBEDT undertook an effort to further explore the feasibility of having a PSH facility built and operated as part of the HECO utility system. HECO performed calculations and prepared cost estimates of an elementary nature to support the integration analysis. This work was performed by the engineering firm of Black & Veatch and is summarized in Section I-3 following.

2. Environmental report

In support of its work on the analysis of alternative supply-side facility plans, HECO had the firm of EnviroSearch International develop an assessment of the environmental issues related to each of the different facility technologies, i.e. coal-fired, oil-fired, wind, and pumped storage hydroelectric.

The work by EnviroSearch was reported in a document titled "Environmental Assessment of Supply-Side Technologies". (3) This report concluded that both the Koko Crater and Kaau Crater projects would have significant impacts on various elements of the environment. Unlike the IRP which analyzed the different facility groupings against each other, the ranking of PSH by EnviroSearch was against environmental criteria. That is, PSH was ranked at each of the two sites in terms of its direct impact on water, air, biodiversity, cultural, physical, etc. For example, coal-fired, oil-fired, and PSH are all ranked "low" in terms of impacts on air quality while it is clear that PSH has a much lower impact on air quality than either coal-fired or oil-fired plants.

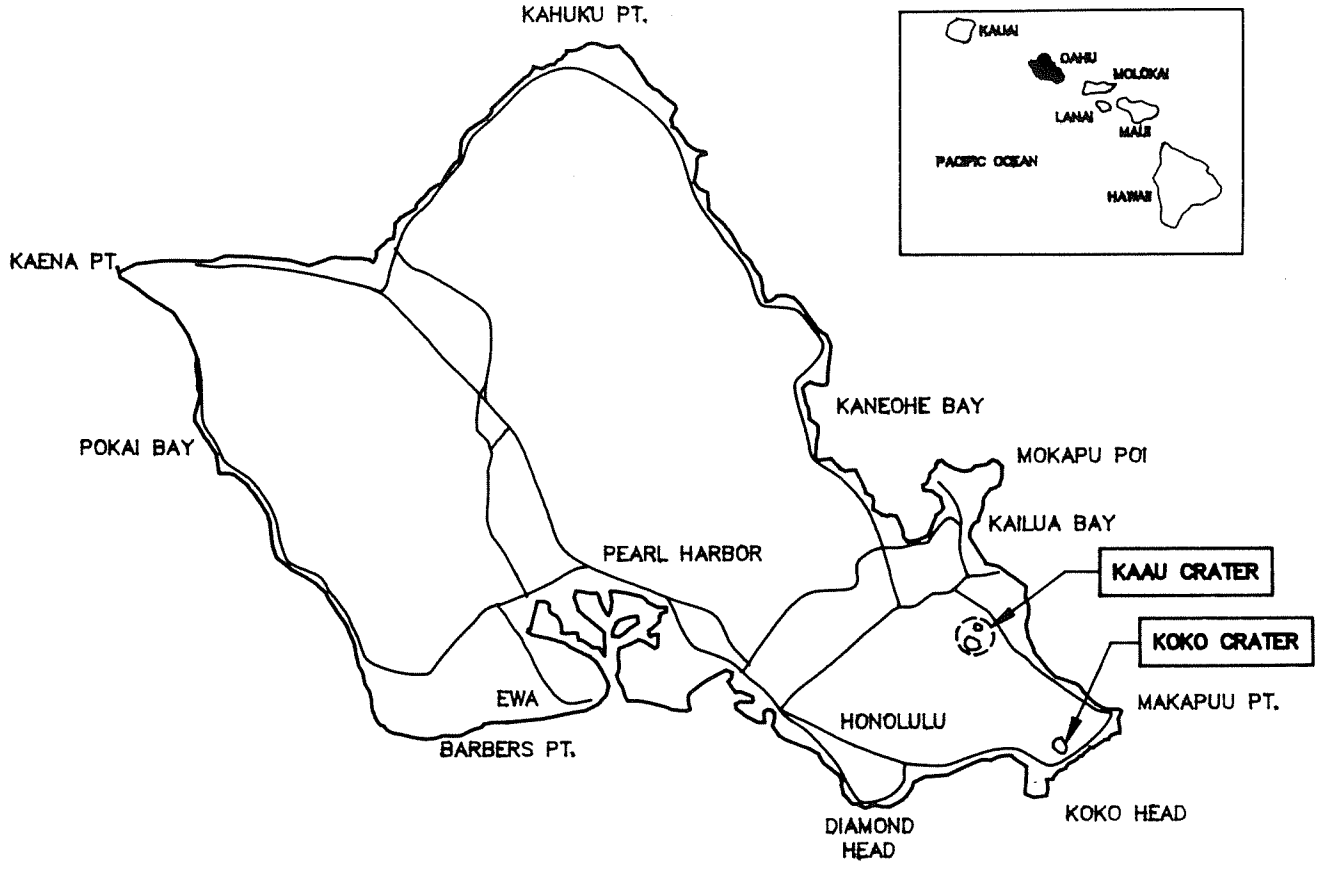
The present report expands on EnviroSearch's work by supplying more detail and specificity to each of the environmental issues and includes an effort to identify mitigating measures for each site.

3. Baseline Design by Black and Veatch (4)

The recognition of PSH as a potential generating facility for HECO led to the development of a conceptual design to provide a better understanding of the technical features and conceptual costs of the projects. Black & Veatch developed elementary concepts with the following features:

		Koko Crater	Kaau/Maunawili
Crater	Power level: MW	160	250
	Reservoir storage: ac-ft	4470	3100
		(1475Mgal)	(1023Mgal)
	Head: ft	345	970
	Surface area: acres	60	53 upper
			46 lower
	Dam height: ft	160	100 upper
			130 lower
	Dam length: ft	750	400 upper
			2670 lower
	Total Capital Cost	$161M	$256M
		$1,007/kw	$1025/kw

The above characteristics formed the basis for the conceptual design described in Section III of this report.



ISLAND OF OAHU

NOT TO SCALE

PROJECT SITE LOCATION

FIGURE 1-1